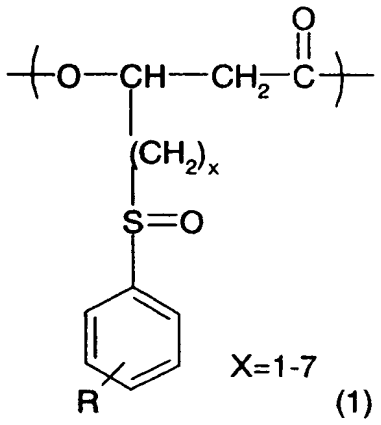
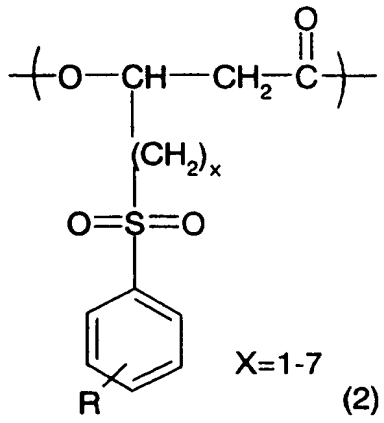
CLAIMS

1. A polyhydroxyalkanoate copolymer comprising at least, per polymer molecule, one kind of unit selected from the group consisting of chemical formulae (1) and (2):



(1)

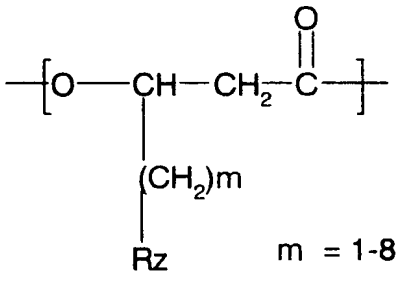
(wherein R is any one selected from the group consisting of H, halogen, CN, NO_2, COOR', SO_2R'' (R' is any one selected from the group consisting of H, Na, K, CH_3 and C_2H_5; R'' is any one selected from the group consisting of OH, ONa, OK, halogen, OCH_3 and OC_2H_5), CH_3, C_2H_5, C_3H_7, $(CH_3)_2$-CH and $(CH_3)_3$-C, and when more than one unit exist, R of each unit can represent any one of the substituents described above independently; and x is an integer selected from 1 to 7 and can differ for each unit)



(2)

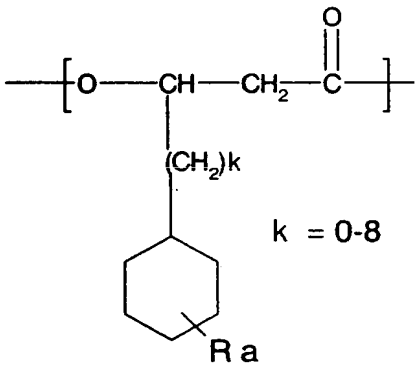
(wherein R is any one selected from the group consisting of H, halogen, CN, NO_2, COO R', SO_2R'' (R' is any one selected from the group consisting of H, Na, K, CH_3 and C_2H_5; R'' is any one selected from the group consisting of OH, ONa, OK, halogen, OCH_3 and OC_2H_5), CH_3, C_2H_5, C_3H_7, $(CH_3)_2$-CH and $(CH_3)_3$-C, and when more than one unit exist, R of each unit can represent any one of the substituents described above independently; and x is an integer selected from 1 to 7 and can differ for unit)

and at least one unit selected from the group consisting of chemical formulae (3) to (6):



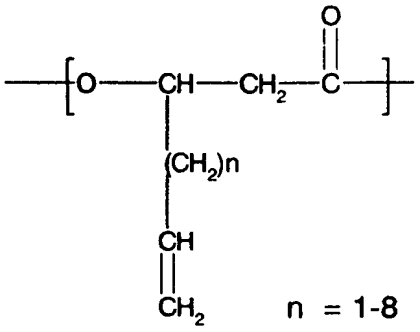
(3)

(wherein m is an integer selected from the range shown in the same chemical formula; Rz comprises a residue having either a phenyl structure or a thienyl structure; and when more than one unit exist, m and Rz of each unit can independently represent any one of the integers and the substituents described above, respectively)



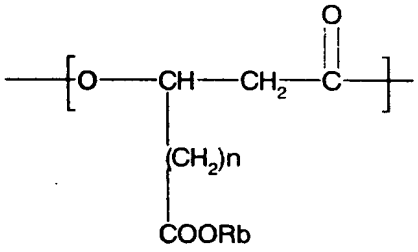
(4)

(wherein R_a is any one selected from the group consisting of H, CN, NO_2, halogen, CH_3, C_2H_5, C_3H_7, CF_3, C_2F_5 and C_3F_7; k is an integer selected from the range shown in the same chemical formula; and when more than one unit exist, k and R_a of each unit can independently represent any one of the integers and the substituents described above, respectively)



(5)

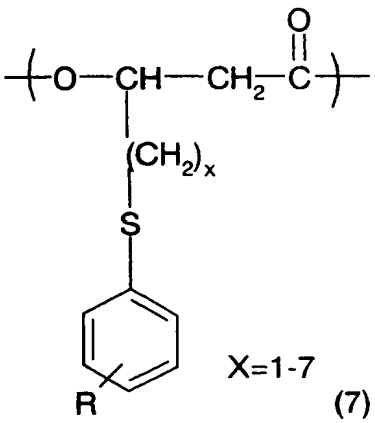
(wherein n is an integer selected from the range shown in the same chemical formula, and when more than one unit exist, n of each unit can represent any one of the integers described above independently)



n = 1-8 (6)

(wherein n is an integer selected from the range shown in the same chemical formula; R_b is any one selected from the group consisting of H, Na and K; and when more than one unit exist, n and R_b of each unit can independently represent any one of the integers and the substituents described above, respectively).

2. The polyhydroxyalkanoate copolymer according to claim 1, further comprising, per polymer molecule, at least one unit selected from the group consisting of 3-hydroxy-(substituted phenylsulfanyl)alkanoic acid units having chemical formula (7):

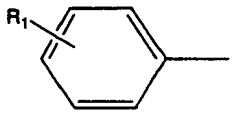


(7)

(wherein R is any one selected from the group consisting of H, halogen, CN, NO_2, COO R', SO_2R'' (R' is any one selected from the group consisting of H, Na, K, CH_3 and C_2H_5; R'' is any one selected from the group consisting of OH, ONa, OK, halogen, OCH_3 and OC_2H_5), CH_3, C_2H_5, C_3H_7, $(CH_3)_2$-CH and $(CH_3)_3$-C, and when more than one unit exist, R of each unit can represent any one of the substituents described above independently; and x is an integer selected from 1 to 7 and can differ for unit).

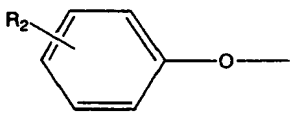
3. The polyhydroxyalkanoate copolymer according to claim 1, wherein Rz in chemical formula

(3) is any one residue selected from the group consisting of chemical formulae (8), (9), (10), (11), (12), (13), (14) and (15):



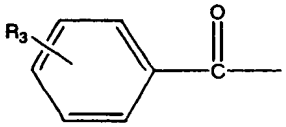
(8)

(wherein R_1 is any one selected from the group consisting of H, halogen, CN, NO_2, COOR' except the substituent introduced into the para- position of the phenyl group (R' is any one selected from the group consisting of H, Na and K), CH_3, C_2H_5, C_3H_7, $CH=CH_2$, CF_3, C_2F_5 and C_3F_7, and when more than one unit exist, R_1 of each unit can represent any one of the substituents described above independently)



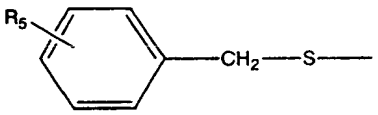
(9)

(wherein R_2 is any one selected from the group consisting of H, halogen, CN, NO_2, CH_3, C_2H_5, C_3H_7, SCH_3, CF_3, C_2F_5 and C_3F_7, and when more than one unit exist, R_1 of each unit can represent any one of the substituents described above independently)



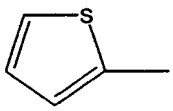
(10)

(wherein R_3 is any one selected from the group consisting of H, halogen, CN, NO_2, CH_3, C_2H_5, C_3H_7, CF_3, C_2F_5 and C_3F_7, and when more than one unit exist, R_3 of each unit can represent any one of the substituents described above independently)

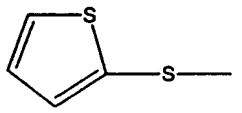


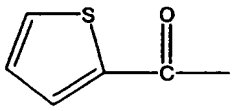
(11)

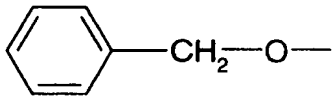
(wherein R_5 is any one selected from the group consisting of H, halogen, CN, NO_2, COOR', SO_2R'' (R' is any one selected from the group consisting of H, Na, K, CH_3 and C_2H_5; R'' is any one selected from the group consisting of OH, ONa, OK, halogen, OCH_3 and OC_2H_5), CH_3, C_2H_5, C_3H_7, $(CH_3)_2$-CH and $(CH_3)_3$-C, and when more than one unit exist, R_5 of each unit can represent any one of the substituents described above independently)



(12)


(13)

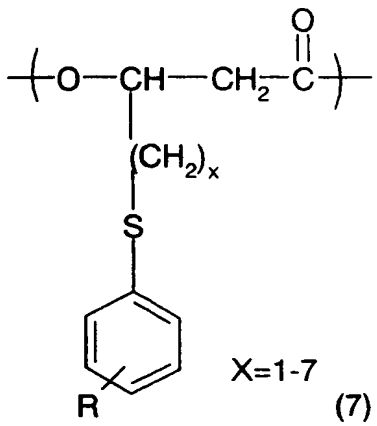

(14)


(15)

and when more than one unit exist, Rz of each unit can represent any one of the residues described above independently.

4. The polyhydroxyalkanoate copolymer according to claim 1, which has a number average molecular weight of 1,000 to 1,000,000.

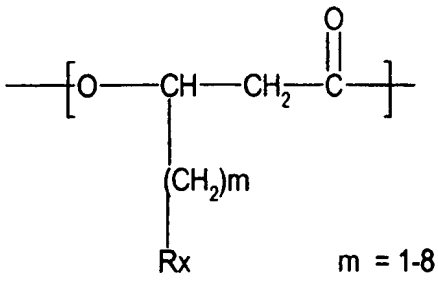
5. A process of preparing a polyhydroxyalkanoate copolymer comprising, per polymer molecule, a 3-hydroxy-(substituted phenylsulfanyl)alkanoic acid unit having chemical formula (7):



(7)

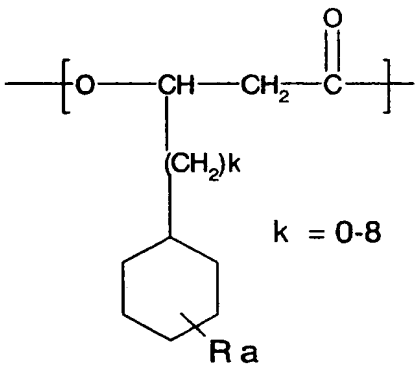
(wherein R is any one selected from the group consisting of H, halogen, CN, NO_2, COOR', SO_2R'' (R' is any one selected from the group consisting of H, Na, K, CH_3 and C_2H_5; R'' is any one selected from the group consisting of OH, ONa, OK, halogen, OCH_3 and OC_2H_5), CH_3, C_2H_5, C_3H_7, $(CH_3)_2$-CH and $(CH_3)_3$-C, and when more than one unit exist, R of each unit can represent any one of the substituents described above independently; and x is an integer selected from 1 to 7 and can differ for unit)

and at least one unit selected from the group consisting of units having chemical formulae (20), (4) and (5):



(20)

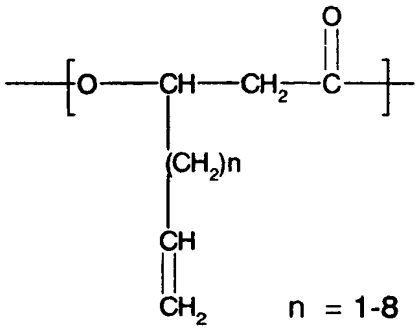
(wherein m is an integer selected from the range shown in the same chemical formula; Rx comprises a residue having either a phenyl structure or a thienyl structure; and when more than one unit exists, m and Rx of each unit can independently represent any one of the integers and the substituents described above, respectively)



(4)

(wherein R_a is any one selected from the group consisting of H, CN, NO_2, halogen, CH_3, C_2H_5, C_3H_7, CF_3, C_2F_5 and C_3F_7; k is an integer selected from the range shown in the same chemical formula; and when more than one unit exist, k and R_a of each unit can independently represent any one of the integers and

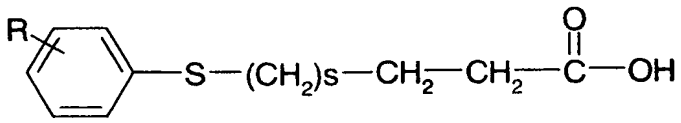
the substituents described above, respectively)



(5)

(wherein n is an integer selected from the range shown in the same chemical formula, and when more than one unit exist, n of each unit can represent any one of the integers described above independently), which comprises the steps of:

allowing a microorganism capable of producing the polyhydroxyalkanoate copolymer to biosynthesize the polyhydroxyalkanoate copolymer under the condition that at least one ω-(substituted phenylsulfanyl)alkanoic acid having chemical formula (16):

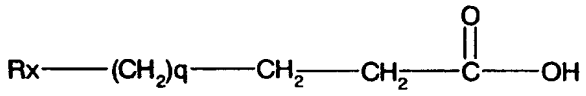


s=1-7 (16)

(wherein R is any one selected from the group consisting of H, halogen, CN, NO_2, COOR', SO_2R'' (R' is any one selected from the group consisting of H,

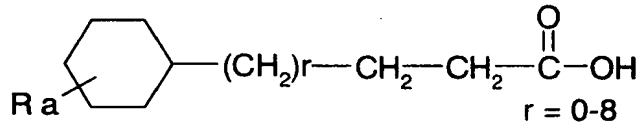
Na, K, CH_3 and C_2H_5; R'' is any one selected from the group consisting of OH, ONa, OK, halogen, OCH_3 and OC_2H_5), CH_3, C_2H_5, C_3H_7, $(CH_3)_2$-CH and $(CH_3)_3$-C, and when more than one unit exist, R of each unit can represent any one of the substituents described above independently; and s is an integer selected from 1 to 7 and can differ for each unit)

and at least one compound selected from the group consisting of compounds having chemical formulae (17), (18) and (19):



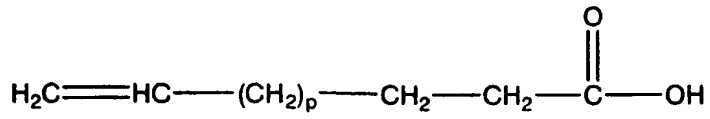
q = 1-8 (17)

(wherein q is an integer selected from the range shown in the same chemical formula; and Rx comprises a residue having either a phenyl structure or a thienyl structure)



(18)

(wherein R_a is any one selected from the group consisting of H, CN, NO_2, halogen, CH_3, C_2H_5, C_3H_7, CF_3, C_2F_5 and C_3F_7; r is an integer selected from the range shown in the same chemical formula)



(19)

(wherein p is an integer selected from the range shown in the same chemical formula) exist.

6. The process of preparing a polyhydroxyalkanoate copolymer according to claim 5, wherein the condition is comprised of cultivating the microorganism in a medium that comprises at least one ω-(substituted phenylsulfanyl)alkanoic acid having chemical formula (16) and at least one compound selected from the group consisting of compounds having chemical formulae (17) to (19).

7. The process of preparing a polyhydroxyalkanoate copolymer according to claim 6, wherein the medium further comprises at least one selected from the group consisting of peptides, yeast extract, organic acids or the salts thereof, amino acids or salts thereof, saccharides, and strait-chain alkanoic acids with 4 to 12 carbon atoms or the salts thereof.

8. The process of preparing a polyhydroxyalkanoate copolymer according to claim 7, wherein the petides are polypeptone; the organic

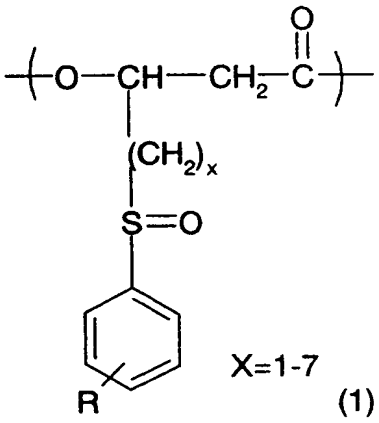
acids or the salts thereof are pyruvic acid, oxalacetic acid, citric acid, isocitric acid, ketoglutaric acid, succinic acid, fumaric acid, malic acid, lactic acid and the salts thereof; the amino acids or the salts thereof are glutamic acid, aspartic acid and the salts thereof; and the saccharides are glyceraldehyde, erythrose, arabinose, xylose, glucose, galactose, mannose, fructose, glycerol, erythritol, xylitol, gluconic acid, glucuronic acid, galacturonic acid, maltose, sucrose and lactose.

9. The process of preparing a polyhydroxyalkanoate copolymer according to claim 6, comprising a step of recovering the polyhydroxyalkanoate copolymer produced by the microorganism from the cells of the microorganism.

10. The process of preparing a polyhydroxyalkanoate copolymer according to claim 5, wherein the microorganism is one classified as Pseudomonas sp.

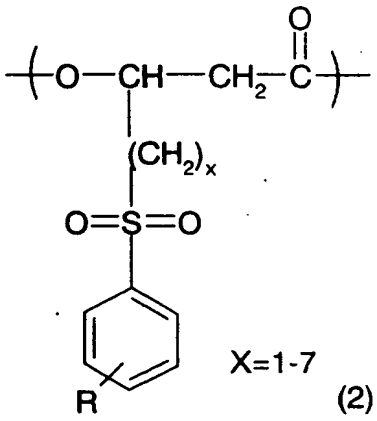
11. The process of preparing a polyhydroxyalkanoate copolymer according to claim 10, wherein the microorganism is any one or more strains selected from the group consisting of Pseudomonas cichorii YN2 (FERM BP-7375), Pseudomonas cichorii H45 (FERM BP-7374) and Pseudomonas jessenii P161 (FERM BP-7376).

12. A process of preparing a polyhydroxyalkanoate copolymer comprising, per polymer molecule, at least one unit selected from the group consisting of formulae (1) and (2):



(1)

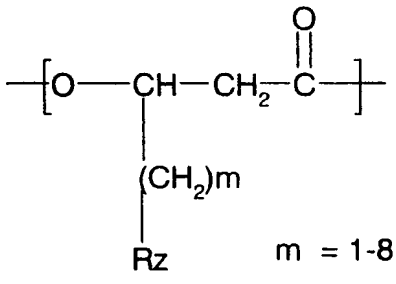
(wherein R is any one selected from the group consisting of H, halogen, CN, NO_2, COOR', SO_2R'' (R' is any one selected from the group consisting of H, Na, K, CH_3 and C_2H_5; R'' is any one selected from the group consisting of OH, ONa, OK, halogen, OCH_3 and OC_2H_5), CH_3, C_2H_5, C_3H_7, $(CH_3)_2$-CH and $(CH_3)_3$-C, and when more than one unit exist, R of each unit can represent any one of the substituents described above independently; and x is an integer selected from 1 to 7 and can differ for each unit)



(2)

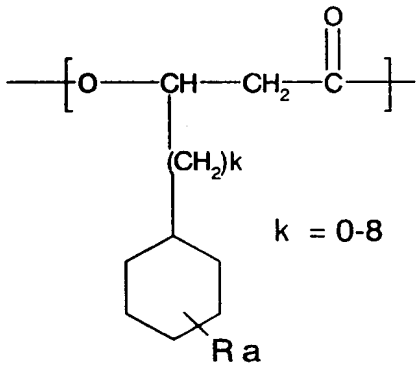
(wherein R is any one selected from the group consisting of H, halogen, CN, NO_2, COOR', SO_2R'' (R' is any one selected from the group consisting of H, Na, K, CH_3 and C_2H_5; R'' is any one selected from the group consisting of OH, ONa, OK, halogen, OCH_3 and OC_2H_5), CH_3, C_2H_5, C_3H_7, $(CH_3)_2$-CH and $(CH_3)_3$-C, and when more than one unit exist, R of each unit can represent any one of the substituents described above independently; and x is an integer selected from 1 to 7 and can differ for unit)

and at least one unit selected from the group consisting of chemical formulae (3) to (6):



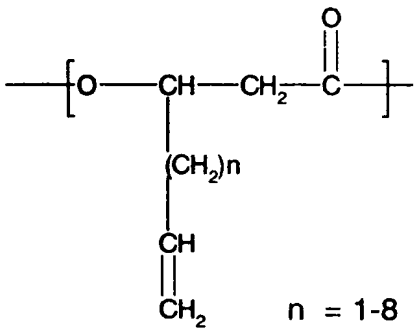
(3)

(wherein m is an integer selected from the range shown in the same chemical formula; Rz comprises a residue having either a phenyl structure or a thienyl structure; and when more than one unit exist, m and Rz of each unit can independently represent any one of the integers and the substituents described above, respectively)



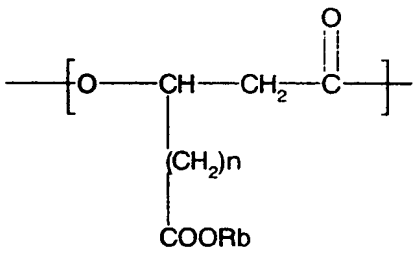
(4)

(wherein R_a is any one selected from the group consisting of H, CN, NO_2, halogen, CH_3, C_2H_5, C_3H_7, CF_3, C_2F_5 and C_3F_7; k is an integer selected from the range shown in the same chemical formula; and when more than one unit exist, k and R_a of each unit can independently represent any one of the integers and the substituents described above, respectively)



(5)

(wherein n is an integer selected from the range shown in the same chemical formula, and when more than one unit exist, n of each unit can represent any one of the integers described above independently)

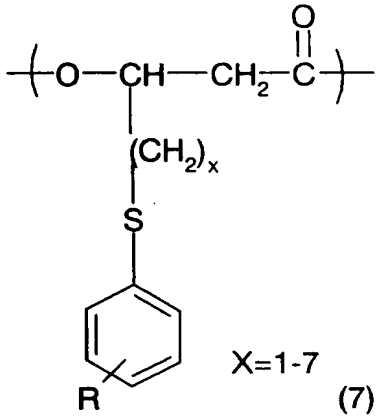


n = 1-8 (6)

(wherein n is an integer selected from the range shown in the same chemical formula; R_b is any one selected from the group consisting of H, Na and K; and when more than one unit exist, n and R_b of each unit can independently represent any one of the integers and the substituents described above, respectively),

which comprises the steps of:

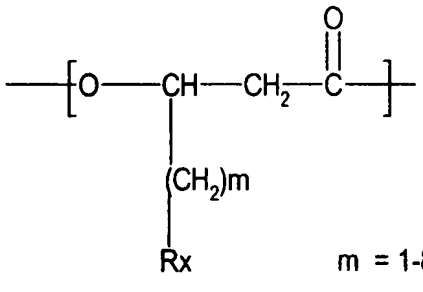
employing as a raw material a polyhydroxyalkanoate copolymer comprising, per polymer molecule, a 3-hydroxy-(substituted phenylsulfanyl)alkanoic acid unit having chemical formula (7):



(7)

(wherein R is any one selected from the group consisting of H, halogen, CN, NO_2, COOR', SO_2R'' (R' is any one selected from the group consisting of H, Na, K, CH_3 and C_2H_5; R'' is any one selected from the group consisting of OH, ONa, OK, halogen, OCH_3 and OC_2H_5), CH_3, C_2H_5, C_3H_7, $(CH_3)_2$-CH and $(CH_3)_3$-C, and when more than one unit exist, R of each unit can represent any one of the substituents described above independently; and x is an integer selected from 1 to 7 and can differ for unit)

and at least one unit selected from the group consisting of chemical formulae (4), (5) and (20):



(20)

(wherein m is an integer selected from the range shown in the same chemical formula; Rx comprises a residue having either a phenyl structure or a thienyl structure; and when more than one unit exists, m and Rx of each unit can independently represent any one of the integers and the substituents described above, respectively)

and oxidizing at a time the 3-hydroxy-(substituted phenylsulfanyl)alkanoic acid unit having chemical formula (7) and the at least one unit selected from the group consisting of chemical formulae (4), (5) and (20).

13. The process of preparing a polyhydroxyalkanoate copolymer according to claim 12, wherein the polyhydroxyalkanoate copolymer as the raw material is prepared by any one process selected from the group consisting of processes according to claims 5 to 11.

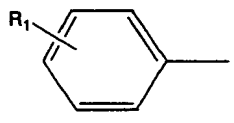
14. The process of preparing a polyhydroxyalkanoate copolymer according to claim 13, wherein the oxidation is conducted using one or more

oxidizing agents selected from the group consisting of permanganate, bichromate, periodate, hydrogen peroxide, sodium percarbonate, metachloroperbenzoate, performic acid and peracetic acid.

15. The process of preparing a polyhydroxyalkanoate copolymer according to claim 14, wherein the oxidizing agent is permanganate and the oxidizing treatment is performed under acidic conditions.

16. The process of preparing a polyhydroxyalkanoate copolymer according to claim 13, wherein the oxidization is conducted using ozone.

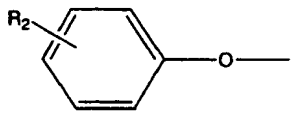
17. The process of preparing a polyhydroxyalkanoate copolymer according to claim 12, wherein Rz in chemical formula (3) is at least any one kind of residue selected from the group consisting of chemical formulae (8), (9), (10), (11), (12), (13), (14) and (15):



(8)

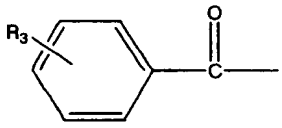
(wherein R_1 is any one selected from the group consisting of H, halogen, CN, NO_2, COOR' except the substituent introduced into the para- position of the phenyl group (R' is any one selected from the group consisting of H, Na and K), CH_3, C_2H_5, C_3H_7, $CH=CH_2$, CF_3,

C_2F_5 and C_3F_7, and when more than one unit exist, R_1 of each unit can represent any one of the substituents described above independently)



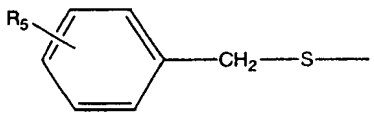
(9)

(wherein R_2 is any one selected from the group consisting of H, halogen, CN, NO_2, CH_3, C_2H_5, C_3H_7, SCH_3, CF_3, C_2F_5 and C_3F_7, and when more than one unit exist, R_1 of each unit can represent any one of the substituents described above independently)



(10)

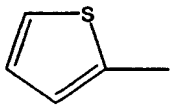
(wherein R_3 is any one selected from the group consisting of H, halogen, CN, NO_2, CH_3, C_2H_5, C_3H_7, CF_3, C_2F_5 and C_3F_7, and when more than one unit exist, R_3 of each unit can represent any one of the substituents described above independently)



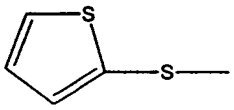
(11)

(wherein R_5 is any one selected from the group consisting of H, halogen, CN, NO_2, COOR', SO_2R'' (R'

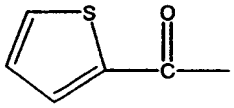
is any one selected from the group consisting of H, Na, K, CH_3 and C_2H_5; R'' is any one selected from the group consisting of OH, ONa, OK, halogen, OCH_3 and OC_2H_5), CH_3, C_2H_5, C_3H_7, $(CH_3)_2$-CH and $(CH_3)_3$-C, and when more than one unit exist, R_5 of each unit can represent any one of the substituents described above independently)



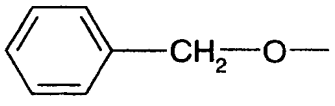
(12)



(13)

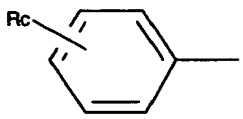


(14)



(15)

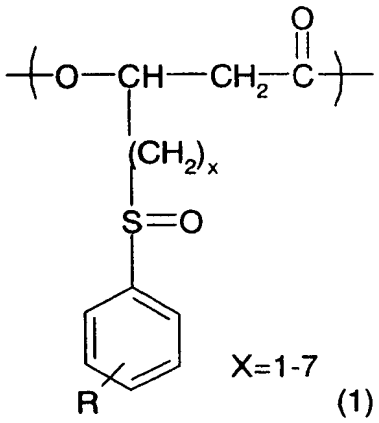
and Rx in chemical formula (20) is at least any one kind of residue selected from the group consisting of chemical formulae (9), (10), (11), (12), (13), (14), (15) and (21):



(21)

(wherein Rc is any one selected from the group consisting of H, halogen, CN, NO_2, CH_3, C_2H_5, C_3H_7, $CH=CH_2$, CF_3, C_2F_5 and C_3F_7 , and when more than one unit exist, Rc of each unit can represent any one of the substituents described above independently).

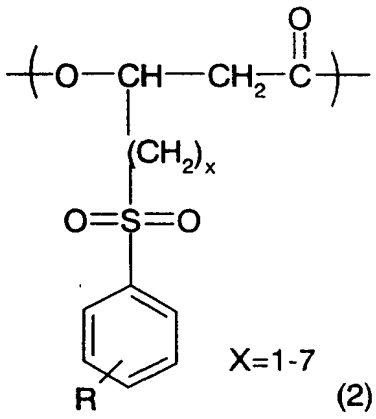
18. A resin composition comprising a resin (A) that is comprised of a polyhydroxyalkanoate comprising, per polymer molecule, at least one unit selected from the group consisting of 3-hydroxy-(substituted phenylsulfinyl)alkanoic acid units having chemical formula (1) and 3-hydroxy-(substituted phenylsulfonyl)alkanoic acid units having chemical formula (2):



(1)

(wherein R is any one selected from the group

consisting of H, halogen, CN, NO_2, COOR', SO_2R'' (R' is any one selected from the group consisting of H, Na, K, CH_3 and C_2H_5; R'' is any one selected from the group consisting of OH, ONa, OK, halogen, OCH_3 and OC_2H_5), CH_3, C_2H_5, C_3H_7, $(CH_3)_2$-CH and $(CH_3)_3$-C, and when more than one unit exist, R of each unit can represent any one of the substituents described above independently; and x is an integer selected from 1 to 7 and can differ for each unit)



(2)

(wherein R is any one selected from the group consisting of H, halogen, CN, NO_2, COOR', SO_2R'' (R' is any one selected from the group consisting of H, Na, K, CH_3 and C_2H_5; R'' is any one selected from the group consisting of OH, ONa, OK, halogen, OCH_3 and OC_2H_5), CH_3, C_2H_5, C_3H_7, $(CH_3)_2$-CH and $(CH_3)_3$-C, and when more than one unit exist, R of each unit can represent any one of the substituents described above independently; and x is an integer selected from 1 to

7 and can differ for unit)
and a thermoplastic resin (B) that comprises no unit selected from the group consisting of 3-hydroxy-(substituted phenylsulfinyl)alkanoic acid units having chemical formula (1) and 3-hydroxy-(substituted phenylsulfonyl)alkanoic acid units having chemical formula (2), the content of the resin (A) being higher than that of the resin (B) in terms of mass percentage.

19. The resin composition according to claim 18, wherein the thermoplastic resin (B) is comprised of one or more resins selected from the group consisting of polyester-based resin, polystyrene-based resin, polypropylene-based resin, polyethylene terephthalate-based resin, polyurethane-based resin, polyvinyl-based resin and polyamide-based resin.

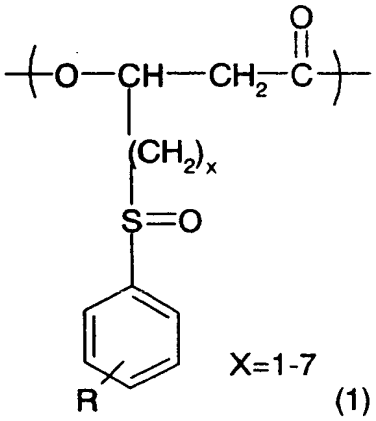
20. The resin composition according to claim 19, wherein the polystyrene-based resin is polystyrene.

21. The resin composition according to claim 19, wherein the polyester-based resin is poly-ε-caprolactone or polylactic acid.

22. The resin composition according to claim 18, further comprising an additive for resin.

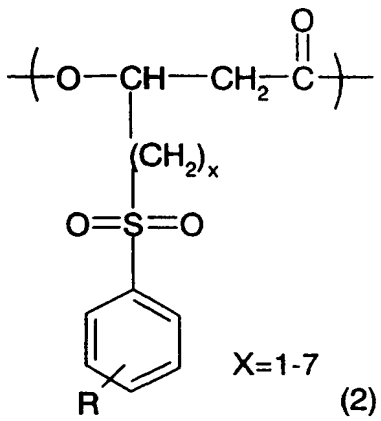
23. A resin composition comprising a resin (A) that is comprised of a polyhydroxyalkanoate comprising, per polymer molecule, at least one unit

selected from the group consisting of 3-hydroxy-(substituted phenylsulfinyl)alkanoic acid units having chemical formula (1) and 3-hydroxy-(substituted phenylsulfonyl)alkanoic acid units having chemical formula (2):



(1)

(wherein R is any one selected from the group consisting of H, halogen, CN, NO_2, COOR', SO_2R'' (R' is any one selected from the group consisting of H, Na, K, CH_3 and C_2H_5; R'' is any one selected from the group consisting of OH, ONa, OK, halogen, OCH_3 and OC_2H_5), CH_3, C_2H_5, C_3H_7, $(CH_3)_2$-CH and $(CH_3)_3$-C, and when more than one unit exist, R of each unit can represent any one of the substituents described above independently; and x is an integer selected from 1 to 7 and can differ for each unit)

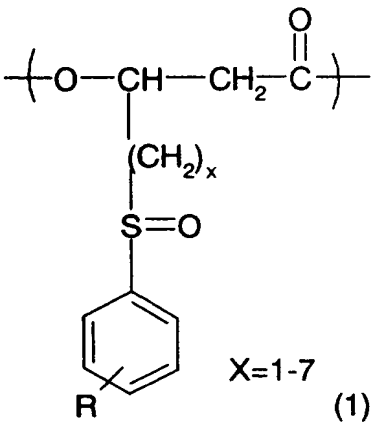


(2)

(wherein R is any one selected from the group consisting of H, halogen, CN, NO_2, COOR', SO_2R'' (R' is any one selected from the group consisting of H, Na, K, CH_3 and C_2H_5; R'' is any one selected from the group consisting of OH, ONa, OK, halogen, OCH_3 and OC_2H_5), CH_3, C_2H_5, C_3H_7, $(CH_3)_2$-CH and $(CH_3)_3$-C, and when more than one unit exist, R of each unit can represent any one of the substituents described above independently; and x is an integer selected from 1 to 7 and can differ for unit)
and an additive for resin.

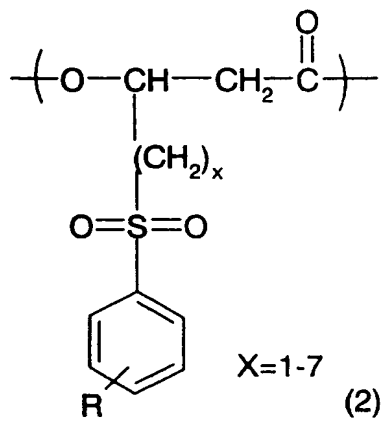
24. A resin for being decomposed by microorganisms comprising: the resin comprising a polyhydroxyalkanoate comprising, per polymer molecule, at least one unit selected from the group consisting of 3-hydroxy-(substituted phenylsulfinyl)alkanoic acid units having chemical formula (1) and 3-hydroxy-(substituted phenylsulfonyl)alkanoic acid units

having chemical formula (2):



(1)

(wherein R is any one selected from the group consisting of H, halogen, CN, NO_2, COOR', SO_2R'' (R' is any one selected from the group consisting of H, Na, K, CH_3 and C_2H_5; R'' is any one selected from the group consisting of OH, ONa, OK, halogen, OCH_3 and OC_2H_5), CH_3, C_2H_5, C_3H_7, $(CH_3)_2$-CH and $(CH_3)_3$-C, and when more than one unit exist, R of each unit can represent any one of the substituents described above independently; and x is an integer selected from 1 to 7 and can differ for each unit)



(2)

(wherein R is any one selected from the group consisting of H, halogen, CN, NO_2, COOR', SO_2R'' (R' is any one selected from the group consisting of H, Na, K, CH_3 and C_2H_5; R'' is any one selected from the group consisting of OH, ONa, OK, halogen, OCH_3 and OC_2H_5), CH_3, C_2H_5, C_3H_7, $(CH_3)_2$-CH and $(CH_3)_3$-C, and when more than one unit exist, R of each unit can represent any one of the substituents described above independently; and x is an integer selected from 1 to 7 and can differ for unit).

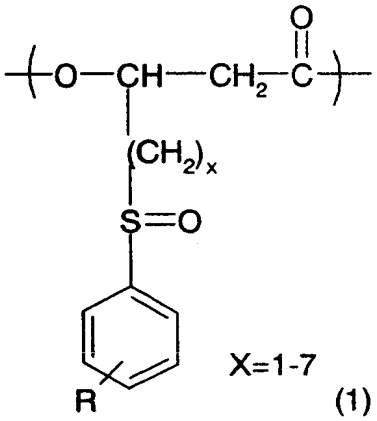
25. A method of decomposing a resin comprising the steps of:

providing the resin;

decomposing the resin in contacting with microorganisms,

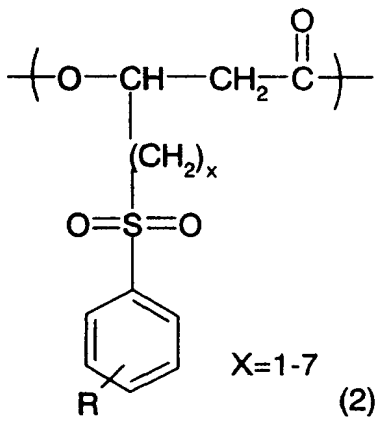
wherein the resin comprises a polyhydroxyalkanoate comprising, per polymer molecule, at least one unit selected from the group consisting of 3-hydroxy-

(substituted phenylsulfinyl)alkanoic acid units having chemical formula (1) and 3-hydroxy-(substituted phenylsulfonyl)alkanoic acid units having chemical formula (2):



(1)

(wherein R is any one selected from the group consisting of H, halogen, CN, NO_2, COOR', SO_2R'' (R' is any one selected from the group consisting of H, Na, K, CH_3 and C_2H_5; R'' is any one selected from the group consisting of OH, ONa, OK, halogen, OCH_3 and OC_2H_5), CH_3, C_2H_5, C_3H_7, $(CH_3)_2$-CH and $(CH_3)_3$-C, and when more than one unit exist, R of each unit can represent any one of the substituents described above independently; and x is an integer selected from 1 to 7 and can differ for each unit)

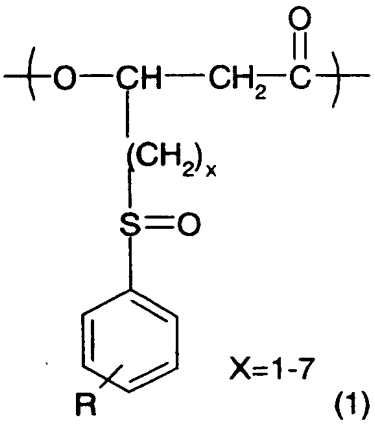


(2)

(wherein R is any one selected from the group consisting of H, halogen, CN, NO_2, COOR', SO_2R'' (R' is any one selected from the group consisting of H, Na, K, CH_3 and C_2H_5; R'' is any one selected from the group consisting of OH, ONa, OK, halogen, OCH_3 and OC_2H_5), CH_3, C_2H_5, C_3H_7, $(CH_3)_2$-CH and $(CH_3)_3$-C, and when more than one unit exist, R of each unit can represent any one of the substituents described above independently; and x is an integer selected from 1 to 7 and can differ for unit).

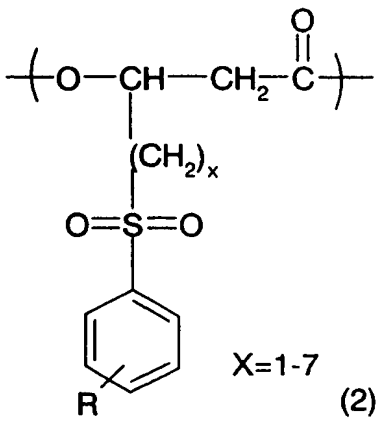
26. A binder resin for forming a resin-based powder or granular material, wherein the binder resin comprises a polyhydroxyalkanoate comprising, per polymer molecule, at least one unit selected from the group consisting of 3-hydroxy-(substituted phenylsulfinyl)alkanoic acid units having chemical formula (1) and 3-hydroxy-(substituted phenylsulfonyl)alkanoic acid units having chemical

formula (2):



(1)

(wherein R is any one selected from the group consisting of H, halogen, CN, NO_2, COOR', SO_2R'' (R' is any one selected from the group consisting of H, Na, K, CH_3 and C_2H_5; R'' is any one selected from the group consisting of OH, ONa, OK, halogen, OCH_3 and OC_2H_5), CH_3, C_2H_5, C_3H_7, $(CH_3)_2$-CH and $(CH_3)_3$-C, and when more than one unit exist, R of each unit can represent any one of the substituents described above independently; and x is an integer selected from 1 to 7 and can differ for each unit)



(2)

(wherein R is any one selected from the group consisting of H, halogen, CN, NO_2, COOR', SO_2R'' (R' is any one selected from the group consisting of H, Na, K, CH_3 and C_2H_5; R'' is any one selected from the group consisting of OH, ONa, OK, halogen, OCH_3 and OC_2H_5), CH_3, C_2H_5, C_3H_7, $(CH_3)_2$-CH and $(CH_3)_3$-C, and when more than one unit exist, R of each unit can represent any one of the substituents described above independently; and x is an integer selected from 1 to 7 and can differ for unit).

27. The binder resin according to claim 26, further comprising a thermoplastic resin other than the polyhydroxyalkanoate, wherein the content of the polyhydroxyalkanoate is higher than that of the thermoplastic resin in content by weight.

28. The binder resin according to claim 27, wherein the thermoplastic resin is one or more selected from the group consisting of

polycaprolactone and polylactic acid.

29. The binder resin according to claims 26, wherein the number average molecular weight of the binder resin is 2,000 or more and 300,000 or less.

30. The binder resin according to claims 26, wherein the glass transition point of the binder resin is 30 to 80°C and the softening point of the same is 60 to 170°C.

31. The binder resin according to claim 26, wherein the resin-based powder or granular material is a toner for developing electrostatic charge images.

32. A toner for developing electrostatic charge images, wherein the toner comprises the binder resin according to claims 26.

33. A method for forming an image comprising the steps of: charging an electrostatic latent image carrier by applying voltage to a charging member from outside; forming an electrostatic charge image on the charged electrostatic latent image carrier; developing the electrostatic charge image with a toner for developing electrostatic charge images to form a toner image on the electrostatic latent image carrier; transferring the toner image on the electrostatic latent image carrier to a recording medium; and fixing the toner image on the recording medium by heat, wherein the toner for developing electrostatic charge images according to claim 32 is

used.

34. The image forming method according to claim 33, wherein the transferring step comprises a first transferring step of transferring the toner image on the electrostatic latent image carrier to an intermediate transfer medium and a second transferring step of transferring the toner image on the intermediate transfer medium to the recording medium.

35. An image forming apparatus comprising a charging means of charging an electrostatic latent image carrier by applying voltage to a charging member from outside; an electrostatic charge image forming means of forming an electrostatic charge image on the charged electrostatic latent image carrier; a developing means of developing the electrostatic charge image with a toner for developing electrostatic charge images to form a toner image on the electrostatic latent image carrier; a transferring means of transferring the toner image on the electrostatic latent image carrier to a recording medium; and a fixing means of fixing the toner image on the recording medium by heat, wherein the toner for developing electrostatic charge images according to claim 32 is used.

36. The image forming apparatus according to claim 35, wherein the transferring means comprises a

first transferring means of transferring the toner image on the electrostatic latent image carrier to an intermediate transfer medium and a second transferring means of transferring the toner image on the intermediate transfer medium to the recording medium.